**Investigation of Epidemic**

**Framework:**

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* **Components of outbreak investigation**
* **Information of outbreak**
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**Introduction:**

Outbreaks can occur anywhere, from a very remote area where no health facility exists to nosocomial outbreaks in a very sophisticated hospitals

It provides opportunity to discover new etiological agents, to understand factors that promote the spread of the diseases and at the same time to identify the weakness of the existing prevention and health programmes.

Outbreaks may be detected when routine, timely analysis of surveillance e.g data , reveals an increase in reported cases or an unusual clustering of cases. Most outbreaks come to the attention of health authorities when a clinician reports health department.

Members of the affected group are important reporting source for apparent clusters of both infectious and non-infectious disease.

**e.g** Someone may call a health department and report that he and several co-workers came down with severe gastroenteritis after attending banquet nights.

**e.g.** A local citizen may call a health department and inform about several cases of cancer diagnosed among his neighbors .

**Definitions:**

**1.Outbreak:** It defines when diseases or health events occur at a greater frequency than normally expected in specified place &person

e.g.: outbreak of HIV i.e. When there is a sharp increase in the number of HIV cases among sex workers in a city where the rate was low in the previous year.

**2.Epidemic:** It defines when diseases or health events occur in a very wide geographical area and involves large population.

e.g. When there is high prevalence of HIV is found among the commercial sex workers in many cities of the country it is known as epidemic of HIV

**3.Cluster:** A group of cases in a certain place over a particular period without regard to whether the number of cases is more than expected.

**Objectives:**

1. Control and preventive measures

2. Research opportunities

3. Training

4. Public, political, or legal concerns

5. Program considerations

**1. Control and preventive measures:**

Before we can develop control strategies for an outbreak, we must identify,

-Where the outbreak is in its natural course ?

-Are cases occurring in increasing numbers?

-Is the outbreak just about over?

Depending upon the following questions we can frame two objectives

1. To assess the extent of the outbreak and the size and characteristics of the population at risk in order to design and implement appropriate control measures.
2. To identify factors which contributed to the outbreak in order to design and implement measures that would prevent similar outbreaks in the future.

If we know about the source and modes of transmission then we can design appropriate control measures

Known Unknown

|  |  |  |  |
| --- | --- | --- | --- |
| Causative agent | Known  Unknown | Investigation+  Control +++ | Investigation+++  Control + |
| Investigation+++  Control + | Investigation+++  Control + |

**+++=**Highest priority , +=lowest priority

The above table shows that , if we know little about the source and mode of transmission, indicated in the Rt column of the table, we must investigate further before we can design appropriate control measures. In contrast, if we can know the source and mode of transmission, as indicated in the Lt column, control measures can implemented immediately. If we don’t know what an agent is as indicated in the bottom row of the table, we must investigate further to identify the agent.

The decisions regarding whether and how to investigate an outbreak depends upon certain characteristic like the severity of the illness, the source and modes of transmission and the availability of prevention and control measures. It is particularly urgent to investigate an outbreak when the disease is severe with high risk of (hospitalization, complications and death) and has a potential to affect others.

e.g.: In United States every case of plague and botulism is investigated immediately to identify and eradicate the source.

e.g Cases of syphilis ,tuberculosis, and measles are investigated to promptly to identify contacts and interrupt further transmission

e.g. In Mexico, Eosinophilia-myalgia syndrome was identified when a physician identified that three patients presented with unusual complaints and that was with the ingestion of L-tryptophan Immediate action was taken and the product was immediately withdrawn from the market and people were warned not to take L-tryptophan .

**2. Research opportunities:**

From the outbreak investigation we gain additional knowledge. Each outbreak helps to study the nature history of disease. For a newly recognized disease, field investigation provides an opportunity to define the natural history—including agent, mode of transmission, incubation period and the clinical spectrum of the disease.

With this investigators can identify the high risk population and specific risk factors for the new diseases like Legionnaires disease in Philadelphia in 1976,toxic shock syndrome in 1980 ,AIDS in 1980’s EMS in 1989.

Outbreak investigation helps to gain knowledge regarding new epidemiological and laboratory techniques.

**e.g** An outbreak of measles in highly immunized community provides a setting for the investigators to study vaccine efficacy, the effect of vaccination, and the duration of vaccine induced protection

**e.g.** An outbreak of giardiasis was used to study the appropriateness of new clinical case definition

**e.g.** An outbreak of pertussis was used to study the performance of new culture medium

**3.Training:**

Investigating an outbreak requires a combination of diplomacy, logical thinking, problem solving ability, quantitative skills, epidemiological know-how and judgement. These skills improve with practice and experience and so training required for the outbreak investigation

**4. Public, political, or legal concerns:**

Public has taken interest in disease clusters and potential environment exposures and they call health departments to investigate. Many health departments are showing interest to responsibly responsive to public concerns even if the concern has little scientific basis. Several states adopted protocols for investigating disease clusters reported by its citizens. Some investigations are conducted because the laws requires an agency to do so.

e.g. CDC’s National Institute of Occupational Safety and Health(NIOSH) is required to evaluate the risks to health and safety in a work place.

**5. Program considerations:**

Outbreak investigation helps to evaluate the program’s effectiveness. An outbreak of a disease targeted by a public health program may reveal weakness in that program and an opportunity to change or strengthen the program’s efforts and program directors to improve the program’s future directions and strategies. Investigating the causes of an outbreak may identify populations which have been overlooked, failures in the intervention strategy, changes in the agent, or events beyond the scope of the program.

**Information of outbreak:** can be obtained from

**1.Health Personnel:** nurses and doctors working in any hospital can report the unexpected number of cases of any particular disease

**2.Laboratory:** every laboratory /network can serve as an excellent source of outbreak investigation e.g in case of Avian influenza

3. Official disease notification system/or surveillance system

4. Newspaper or media

5.Village health volunteers

* **Components of outbreak investigation**

**Investigator:** Represents the people who are directly involved in planning and conducting the outbreak investigation from start to end.

**Investigative team includes**

1. Field epidemiologist technically competent to conduct field investigation systematically

2. Disease control people who are experienced in implementing basic disease control measures e.g sanitary inspector, ANM

3. Laboratory technicians

4. Specialist in particular areas e.g veterinarian would be very helpful in outbreak of zoonotic disease

5. Public health administration for providing logistic support, mobilizing resources and providing administrative expertise for them

6. Public relation person .In certain conditions when the outbreak has caused panic or gained the intense attention of public, the investigative team should recruit or appoint a person to be in charge of public relations and press releases. This person should appropriately reassure and not unduly alarm the public

* **Steps of an outbreak investigation:**

1. Prepare for field work
2. Confirm the existence of an outbreak
3. Verify the diagnosis and determine the etiology of the disease.
4. Develop case definition, start case finding, and collect information on cases
5. Describe person, place and time and generate hypotheses.
6. Develop hypothesis
7. Test hypotheses
8. Do necessary environmental or other studies to supplement the epidemiological study
9. Establish the cause of outbreak
10. Report and recommend appropriate control measures to concerned authorities at the local/national, and if appropriate at international levels
11. Dissemination of information
12. Follow up to ensure implementation of control measures

1. **Prepare for field work:** Investigators should be well prepared before leaving for the field. Preparations should be grouped into 3 categories

a) Investigation

b) Administration

c) Consultation

**a) Investigation:**

* Investigators should have the appropriate scientific knowledge, supplies and equipment to carry out the investigation.
* Should discuss the situation with someone knowledgeable about the disease and about field investigations, and review the applicable literature.
* Should assemble useful references such as journals articles and sample questionnaires
* Should consult laboratory staff to ensure to take the proper laboratory material and should know the proper collection, storage and transportation techniques.
* Investigator should arrange for portable computer, dictaphone, camera and other supplies

**b) Administration:**

Investigator should make travel and other arrangements and get them approved. If investigation is likely to be lengthy than investigator should take care of personal matters before leaving for the investigation.

**c) Consultation:**

* The investigator must know the expected role in the field.
* Before departure, all parties should agree on the role of investigator particularly if the investigator is coming from outside the local area
* The investigator should provide consultation to the local staff who will conduct the investigation.
* Investigator should know who will be the local contacts and when and where to meet the local officials and contacts .

**2.Confirm the existence of an outbreak:**

The field investigator should verify that a purported outbreak is indeed an outbreak. Some will turn out to be true outbreaks with a common cause, some will be sporadic and unrelated cases of the same disease and others will turn out to be unrelated cases of similar but unrelated diseases. To decide whether the observed number of cases exceeds the expected numbers we need to first determine the expected number of cases i.e whether a cluster is indeed an outbreak.

Compare the current number of cases with the number from the previous few weeks or months or from a comparable period during the previous few years

Most outbreaks come to the attention of health departments by two ways:

1. Regular analysis of surveillance of data
2. Calls from a health care provider/citizen

e.g A member of the public may report 3 infants born with birth defects within a 1-month period in the same community

**How to confirm the existence of outbreak?**

1).For a notifiable disease , health department surveillance records can be used

2).For other diseases and conditions locally data can be collected from hospital

discharge records, mortality statistics, cancer or birth defect registries

3).If local data are not available, rates can be applied from the neighboring states or

national data or can conduct a telephone survey of physicians to determine whether

they have seen more cases of the disease than usual.

1. Finally, can conduct a survey of the community to establish the background or

historical level of the disease.

1. **Verify the diagnosis and determine the etiology of the disease:**

Goals of verifying the diagnosis are

1) To ensure that the problem has been properly diagnosed.

2) To rule out laboratory error as the basis for increase in the number of cases.

For the verification of diagnosis clinical findings and laboratory results should be reviewed. If the laboratory tests are inconsistent with the clinical and epidemiological findings than a qualified laboratorial review is done for the laboratory techniques being used.

Investigator should visit several patients with the disease. In case if a sound clinical background is not known than a qualified physician can be taken for the investigation.

Sometimes just by talking with the patients can gain knowledge regarding clinical features and can develop a mental image of the disease. Certain questions can be asked to the patients to reach to a diagnosis

* What were their exposures before becoming ill?
* What do they think caused their illness?
* Do they know anyone else with the disease?
* Do they have anything in common with others who have the disease?

1. **Develop case definition, start case finding, and collect information on cases**

A case definition includes clinical criteria and particularly in the setting of an out break investigation—restrictions by time, place and person. Clinical criteria may be for e.g elevated antibody titres, fever≥101◦F,three or more loose bowel movements per day, or myalgias severe enough to limit the patients usual activities.

Case definitions can be restricted by

**Time**—Persons with the disease onset within the past 2months

**Place**---To residents of nine country area or to employees of a particular plant.

**Person**—To persons with no previous history of musculoskeletal disease or to pre-menopausal women

**Cases can be classified as**

**Definite case:** A case which is confirmed by laboratory investigation

**e.**g outbreak of bloody diarrhoea and hemolytic uremic syndrome by E.coli 0157:H7 which is isolated from a stool culture

**Probable case:** Bloody diarrhoea**,** with the same person, place and time restrictions.

**Possible case:** Abdominal cramps on diarrhoea at least 3 loose stools in a 24 hr period in a school age child with onset during same period.

Such classification of cases is important in several situations like

* They allow you to keep track of a case even if the diagnosis is not confirmed e.g temporarily case can be diagnosed as probable or possible case while laboratory results are pending.
* In certain situations as the patients physician we don’t do laboratory tests to confirm the diagnosis because the test is expensive, difficult to obtain or unnecessary e.g during a community outbreak of measles which has a characteristic clinical picture ,investigators might follow the usual practice of confirming only new cases and than relying on clinical features to identify the rest of the cases. While investigating the out break of diarrhoea on a cruise ship, investigators usually try to identify an agent from stool samples from a few afflicted persons. If those few cases are confirmed to be infected with the same agent. the other persons with compatible clinical illness are all presumed to be part of the same outbreak

**Start case finding:** Public health workers must therefore “cast the net wide” to determine the geographical extent of the problem and the population affected by it.

First direct your case finding at health care facilities where diagnosis is likely to be made: physicians offices, clinics, hospitals and laboratories.

If we send out a letter describing the situation and asking for reports it is called stimulated or passive surveillance. If we do telephone or visit the facilities to collect information on cases it is known as active surveillance.

In some situations alert to the public directly usually through the local media e.g. outbreaks caused by a contaminated food product such as salmonellosis caused by contaminated milk or L-tryptophan induced EMS announcements in the media alerted the public to avoid that product and to see the physician if they had symptoms compatible with the disease

If an outbreak affects a restricted population such as on cruise ship, in a school or at worksite and if high proportion of cases are unlikely to be diagnosed if for e.g. many cases are mild or asymptomatic then need to conduct a survey of the entire population and determine the occurrence of clinical symptoms and can collect laboratory specimens to determine the number of asymptomatic cases. Can also ask case-patients if they know anyone else with the same condition.

**Collect the following type of information about every case**

1. **Identifying information:** name, address, and telephone number allows investigators to contact patients for additional questions and to notify them of laboratory results and the outcome of the investigation. Names will help in checking for duplicate records while address helps to map the geographical extent of the problem
2. **Demographic information:** age, sex, race, and occupation provides the person characteristics of descriptive epidemiology which helps to characterize the populations at risk.
3. **Clinical information:** helps to verify the case definition. Date of onset helps to allow the time course of the outbreak. Information regarding hospitalization or death helps to describe the spectrum of the illness
4. **Risk factor information:** Investigation of hepatitis A ,information regarding exposure to food and water.
5. **Reporter information:** by identifying the person who provided the case report helps to seek additional clinical information or repot back the results of the investigation.
6. Collected information is described on a standard case report form, questionnaire or data abstraction form. Then the selected critical items are are abstracted on a form called as line listing.
7. Line listing contains key information on every case and can be scanned and updated.In a line listing each column represents an important variable such as name or identification number ,age ,sex ,case classification etc. while each row represents a different case .New cases are added to a line listing as they are identified
8. **Describe person, place and time and generate hypotheses.**

**Person:**

**Index case:** The first case on epidemic curve is index case. It is important with the possibility that he/she brought the infection to the community.

**Outlier case:** The case which appears at the beginning and at the end of the curve are known as outlier case. They provide information about the source and the way disease is spreading in that territory.

**Place:** The investigator can calculate the attack rate of case by different place .This can be place of residence ,place of work and place of exposure and soon plot a spot map showing the source of infection or contamination

If cases are scattered in many place, investigator should explore the secular pattern of the case over time. This will indicate about the spread of outbreak from one area to another area or whether people living in different place had a common exposure

**Time:** Two types of outbreaks

1. Common source

2. Propagated source

**1.Common source outbreak:** This outbreak occurs when people gets the infection by exposure to the same source of infection. These are two types

* **Point common source:** When there is single source that exists for the short time and all case have common exposure to it in that same particular period.

There is sharp rise of many cases suddenly followed by rapid decline.

First case and last case usually happen within one incubation period.

* **Continuous common source:** The epidemic curve shows an abrupt increase in number of cases but instead of having a peak decline within incubation period new cases persist for a longer time with a plateau shape instead of peak before decreasing.

If there are many peaks or irregular jagged curves this suggest an intermittent common source

**2. Propagated source:** This type of outbreak is caused by a transmission from

one person to another person which requires direct contact such as touching,

bitting, sexual contact

Slow increase in number of cases with progressive peaks approximately one incubation period apart. The span of 1st and last case will also last longer than several incubation period e.g HIV

1. **Test hypotheses :**

Hypothesis derived from the above descriptive study is tested using the analytical studies .The most common study is case control study others are historical cohort

1. **Do necessary environmental or other studies to supplement the epidemiological study:** Although an analytical study might be able to confirm the hypothesis ,the investigator still needs to find environment or other evidence to support and explain the epidemiological evidence
2. **Establish the cause of outbreak :**

Once the hypothesis has been tested an other necessary studies have to be done ,the investigator can make the conclusion about the cause of outbreak, this is important because action follows conclusion.

The investigator must identify the cause of outbreak based on the agreement of following piece of evidence

* Laboratory
* Clinical
* Environmental
* Epidemiological

The epidemiological evidence found by the descriptive and analytical study should explain

* Pattern of spread as described by epidemic curve
* Statistical strength of association between exposure an developing the disease
* The dose response relationship which demonstrates high strength by association when exposure is increased
* Exposure should preceed illness

1. **Report and recommend appropriate control measures to concerned authorities at the local/national, and if appropriate at international levels:**

The investigator should timely report the findings to the responsible individuals at local, national and international levels, so that appropriate action should be taken

Two task should be completed before leaving the field

1) Complete analysis and data interpretation

2) Present main finding with recommendations

**Report:** They should be from appropriate approach and it should be sensitive because it may reflect the weakness or mistakes of health and other activities

1) What can be done to control this outbreak?

2) How to improve this ongoing intervention for this outbreak?

3) How to prevent future outbreaks?

4) How to improve the investigation?

5) How to improve surveillance?

**11. Dissemination of information:** It helps to educate general public and community and dissemination is done by print and mass media. Report the investigation result in international journal or bulletin like weekly epidemiological record(WHO),morbidity and mortality weekly report (CDC)

**12. Follow up to ensure implementation of control measures:**

The investigator should follow up the investigation by mainstreaming close communication with the local health authorities. An absence of new cases for at least two incubation periods of the infectious disease under investigation should suggest that the outbreak is subsiding

A good investigator should follow up on the recommendations. If the recommendations were implemented the investigator can also learn the impact by observing the trend of diseases

**References:**

1.CDC module on outbreak investigation

2.Oxford textbook of public health

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